

Interfacial Design of Composite Ablative Materials, Phase I

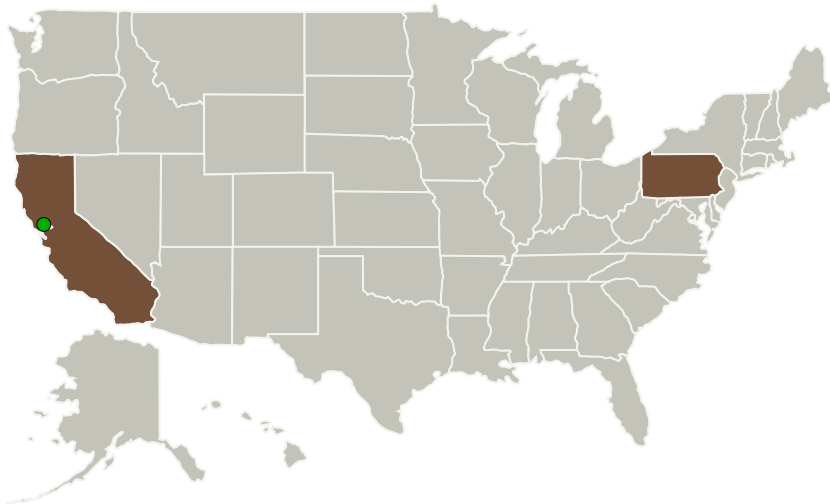
Completed Technology Project (2010 - 2010)



Project Introduction

This Phase I Small Business Innovative Research project proposes to develop a multiscale computational methodology capable of accurate prediction of the properties and performance of insulating ablative materials that are used to protect the re-entry of vehicles from excessive thermal loads. In particular, this effort will focus on multi-million atom, reactive molecular dynamics (MD) simulations of pyrolysis of phenolic resins enhanced with carbon nanotubes (CNT). The results will reveal the role of CNT interface on the reaction and the thermo-mechanical properties. The derived interfacial strength characteristics will then be incorporated into continuum-level simulations. The outcome of Phase I will provide a benchmark to perform MD simulations on pyrolysis of resin composites and methodology development to link atomistic-level with continuum-level simulations. Phase II will involve MD simulations on multi-walled, functionalized CNTs in cross-linked resin, optimization of the multi-scale modeling methodology and experimental validation. The outcome of the multiscale computational program will involve a detailed parametric study to find optimal parameters at multiple scales including: nanofiller diameter size, volume fraction and functionalization of nanotubes and 100-μm-sized carbon fibers. These parameters will be optimized to best meet Orion vehicle's TPS challenges. The team involves engineers from ACT and researchers from Rensselaer Polytechnic Institute.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Advanced Cooling Technologies, Inc.	Lead Organization	Industry	Lancaster, Pennsylvania
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Pennsylvania

Project Transitions

**January 2010:** Project Start**July 2010:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/139929>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Advanced Cooling Technologies, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Tapan G Desai

Co-Investigator:

Tapan Desai

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Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
 - └ TX09.4 Vehicle Systems
 - └ TX09.4.5 Modeling and Simulation for EDL

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System